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ABSTRACT

A preliminary instructional model suitable for lesson preparation for a Computerized Training System is described. Topics discussed include general course architecture, general course structure, and the training decision process. Guidelines for the design of the model are presented and information is provided on the adaptation of the model to three levels of student performance, thus allowing for a learning environment sensitive to individual differences. Flow charts are also given to depict graphically the learning contingencies and instructional strategies addressed in the design of the model. (Author)

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PROJECT ABACUS

Report CTS-TR-73-2 AD________________

A PRELIMINARY INSTRUCTIONAL MODEL FOR A COMPUTERIZED TRAINING SYSTEM

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July 1973

Interim Report

Prepared for
U. S. ARMY TRAINING AND DOCTRINE COMMAND
Fort Monroe, Virginia 23651

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NOTICES

This report has been reviewed and is approved.

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13. ABSTRACT

A preliminary instructional model suitable for lesson preparation for a Computerized Training System (CTS) is described. General course architecture, general course structure, and the training decision process is described. General guidelines for the design of the model are presented. The model is adaptive to three levels of student performance providing a learning environment sensitive to individual differences. Flow charts are included to depict graphically the learning contingencies and instructional strategies addressed in the design of the model.

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FOREWORD

The instructional model described in this report represents an evolutionary step forward in the development of strategies and techniques for training using a Computerized Training System (CTS). It incorporates a number of innovations and a higher order of sophistication not found in the previous model. It is subject to modification and elaboration through the CTS user development program conducted by the Product Manager, CTS, U. S. Army Signal Center and School, under the direction of the U. S. Army Training and Doctrine Command. Subsequent reports on the model will incorporate higher orders of proven sophistication generated through classroom experience.

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PURPOSE

This report has been prepared to serve as a preliminary guide to be used by the instructional programmers of the Computerized Training System Project during the development of the lesson material. Furthermore, the systems programmers will use this report during the programming of the instructional strategies developed for use within the instructional model. Other organizations, using computers as a training media, may be able to use it as a resource when developing instructional models for their own applications.

INTRODUCTION

In this era of evolving training technology, instructional models are playing an ever increasingly important role in structuring the interaction between the student and the subject matter. This is especially true in self-paced training systems which require some means of monitoring the progress of the student and making the kinds of decisions normally made by the instructor in the classroom, or by a tutor. In a self-paced training system, the instructional model serves as a surrogate instructor to make these decisions.

The ideal is to have a model sufficiently comprehensive to accommodate every variable and contingency relevant to achievement of training objectives. It is the purpose of this report to describe a model designed for use with a Computerized Training System (CTS) that will be sensitive to the abilities and needs of the individual, but in no way purports to meet the ideal. This CTS model is an evolutionary development of the models employed in the earlier, successful applications of Computer Assisted Instruction (CAI) at the Signal School. The CTS model described herein includes not only the CAI presentation of lessons, but provides for the off-line management of lessons and administrative services required for a self-paced mode of training.

The CTS instructional model for Project ABACUS is designed with the following characteristics:

a. The model is single track, linear, with branching as was done by models that proved successful in previous applications of CAI to electronics training.[1]

b. To provide individualization of instruction, branching is based on the student's prior experience in the field of study and performance in the course.

c. Remedial branching is based on the student's performance record.

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[1] USCONARC, Technical Report 71-2, An Instructional Model for Computer Assisted Instruction, May 1971.

d. The performance record is dynamic and changes under computer control based on the student's responses.

e. The model is sufficiently flexible to permit a multimedia approach.

f. Recycling under computer control is provided at skill, training objective and lesson level.

g. There is no significant increase in the computer programming or course authoring when compared with the models used previously.

In its current stage of development, the model remains a malleable instrument subject to further modifications warranted by hardware design, experience gained in the integration of multimedia training techniques, and by further advances in the state-of-the-art. Furthermore, the model incorporates the degree of complexity that can be readily utilized in the instructional programming of subject matter without extensive experimentation. This pragmatic approach to instructional model design and development has proven successful in the past and has provided valuable stepping stones for further evolution of viable and reliable models with higher orders of sophistication.

AUTOMATED DATA COLLECTION

Whenever he is signed on the system, the student has an on-line dynamic record area for use by the computer system to manage the student's progress and provide data for administrative purpose. The computer system will, at regular intervals, provide data for required reports. These reports will be processed in real-time or by batch as deemed appropriate.

Real-time reports will include lesson test results, and selected items from the student record required for classroom administration by the instructor staff.

Batch-processed reports will include student response data and predicted completion date.

As experience is gained with the computerized training system, it is conceivable that a number of registrar reports will be incorporated as part of the system. This, as with the instructional model, must be an evolutionary process.

GENERAL COURSE ARCHITECTURE

The general course architecture of the instructional model is shown in figure 1. The definition and function of each component is as follows.

GENERAL COURSE ARCHITECTURE

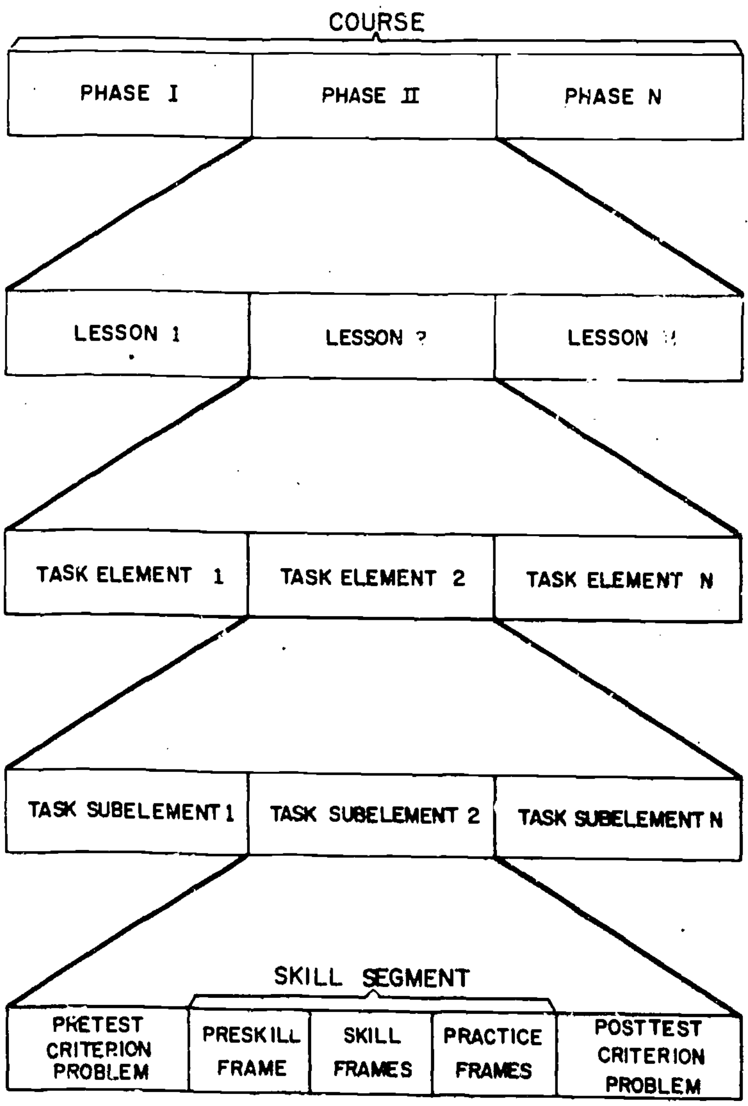

FIGURE 1

Course - The course encompasses the total organization of all subject matter and strategies designed to achieve specified levels of student performance in a major occupational speciality or a major task or skill area. The terminal performance objectives for the course are derived through the systems engineering of training procedures of the occupational specialty, task or skill area for which training will be provided. A course consists of as many phases as necessary to achieve all terminal performance objectives.

Phase - A phase is a major block of instruction within the course consisting of a subset of performance objectives for the course. A phase consists of a combination of lessons and practical exercises arranged in a logical sequence to facilitate achievement of the objectives. Each phase normally terminates in a written and/or performance test. The lessons, practical exercises, and phase test can either be on line or off line. The course is designed to provide functionally oriented training with an optimum amount of "hands-on" training. It should be stressed that all off-line instruction and testing is self-paced in agreement with the self-paced nature of the CTS. The CTS instructional model in this report details the CAI portions of the course, while providing for off-line as well as computer-directed lessons. A phase includes as many lessons as necessary to achieve the established objectives.

Lesson - A lesson is a self-contained unit designed to enable the students to acquire specific skills. The lesson is the smallest "stand-alone" component of the course. The lesson, because it is self-contained, can be used to supplement instruction in a specific skill area outside the framework of the course. Each lesson consists of specific task elements.

Task Element - A task element contains one or more skill-oriented task subelements that are required to attain a skill or knowledge established as part of a terminal performance objectives.

Task Subelement - The task subelement is an instructional sequence designed to enable a student to develop a specific skill. A number of task subelements are required for the development of a task. Each task subelement has three major components as follows:

a. <u>Pretest Criterion Problem</u> - Permits a student with prior experience to skip lesson material related to skills and knowledges he already possesses.

b. <u>Skill Segment</u> - The component that develops one of the skills or knowledges required by the task element. The skill segment has three parts. These are:

(1) <u>Preskill Frame</u> - Provides the high-performance student with a narrative overview of the skill or knowledge so he may skip directly to the posttest criterion problem without going through the response frames.

(2) Skill Frame - Provides a small segment of information keyed to a response. A series of skill frames is required to develop the skill or knowledge in the task subelement.

(3) Practice Frame - Provides low-performance students with additional drill and practice for reinforcement.

c. Posttest Criterion Problem - Provides a test point to ascertain that the student has acquired the knowledge or developed the skill presented in the skill segment.

GENERAL COURSE STRUCTURE

The CTS general course structure, shown in ANNEX A, figure A-1, is designed for any mixture of three modes of self-paced presentation of lesson material. For purposes of clarity in this report, the three modes of self-paced instruction will be defined as follows:

a. Computer Assisted Instruction (CAI) Mode - In this mode, the lesson material is stored on line within the computer system and the computer serves as the instructional medium.

b. Computer Managed Instruction (CMI) Mode - In this mode, the computer provides lesson assignments, schedules equipment and instructional media, scores tests and provides remedial work, and monitors student progress. All lesson material is presented via off-line media.

c. Computer Directed Instruction (CDI) Mode - This mode may be considered as a combination of CAI and CMI with part of the lesson material stored on line and part off line. The computer is one of several instructional media used within the lesson.

The provision for three modes of instruction encourages the use of multimedia lesson presentations. The mode and media selected by the instructional programmer will be the one most suitable to the subject matter. It is conceivable that all three modes will be used by the student to attain the objectives of a single task element. The use of the off-line mode will permit the integration of existing self-paced lessons, thus expediting the development of the course of training.

Regardless of the mode of instruction used, the task element problem will be on line. The task element problem is primarily a test so that computer-prescribed remediation can be provided for those students who have failed to achieve the objectives for that portion of the lesson.

Even though the course will be taught using the functional approach to training, a provision is made for practical exercises within a lesson. These practical exercises may be CAI, CDI, or CMI, and will be presented prior to the lesson test.

The lesson test will be an on-line evaluation instrument to determine if the student has attained sufficient skills and knowledges to continue in the phase. If a student fails the lesson test, appropriate remediation will be provided at this point.

Lesson tests will be given at pedogogically appropriate intervals, approximately every four to eight hours of instruction for the middle-performance student. A printout will be provided on each student's achievement at these points in the phase.

Each phase is approximately two to three weeks long for the middle performance student and consists of a number of related lessons. Each phase terminates with a test. This test may be written, performance, or a combination of both. If a student fails the phase test, an administrative determination must be made as to the student's future in the course.

TRAINING DECISION PROCESS

The general course structure provides the framework of the course and shows the interrelationship of the major components. However, it is the training decision process (Annex A, figure A-2) that determines the student's instructional path through the course. The training decision process developed for this instructional model makes provision for individual differences based upon prior experience, performance, and the student's response.

When the student is registered into the system, two items of data used by the training decision process are entered into the student's record in the form of discrete digits. These items are his prior experience, and his performance record. The prior experience code will be binary in nature indicating a yes or no, whereas, the performance record will be some decimal number derived from a predictor algorithm using the individual's Army Classification Battery scores.

At the start of each task subelement, the student's record is checked to see if he has had prior experience related to the course material. If the student has had prior experience, he is given a pretest criterion problem. If he passes the problem, he skips the task subelement and advances to the next task subelement. Should the student fail the pretest criterion problem, he would go through the task subelement following the path determined by his performance history. A right or wrong response to a pretest criterion problem does not affect the student's performance record. The rationale for this is, that at this point the student's prior experience is being evaluated and not his potential achievement. At some point in a course, it is conceivable the pretest criterion problem will be initially bypassed by all students. This would be true in those portions of a course where the probability of prior experience would be minimal. Those students who do not pass the pretest criterion problem, as well as those who do not have prior experience, are branched to the skill element of the teaching unit. The skill element may be presented on line, off line, or be computer directed. The following paragraphs will discuss on-line presentations.

The training decisions from this point on will be predicated on the student's performance record and his current response. If his prior performance is high, the student will be given a preskill frame that consists of one or more narrative screen displays presenting the salient facts on skills covered by the skill segment. The high-performance student skips forward to the posttest criterion problem, bypassing the skill and practice frames. The middle- and low-performance students go directly to the skill frames. The skill frames are used to teach a small increment of the knowledge or skill to be attained. A skill frame consists of a message display and a response display with its associated confirmation and remediation display. A series of skill frames are required to develop a skill or teach a concept. At the end of the series of skill frames, the high- and middle-performance students skip directly to the posttest criterion problem whereas the low-performance student is given additional reinforcement of the concept or skill by use of drill and practice problems in the practice frames before being presented with the posttest criterion problem.

The posttest criterion problem serves as a test to determine if the required concept or skill has been mastered. It will be used to evaluate the student's progress for all CAI and CDI presentations. The posttest criterion problem, can, at the instructional programmer's option, be used to evaluate and provide remediation and confirmation of skills and concepts taught off line. The discussion that follows reflects evaluation of CAI presentation, but can be readily adapted to CDI or off-line presentations.

When a student passes a posttest criterion problem, he is sent directly to the next task subelement. However, those who fail are provided remediation based upon their performance record. The high-performance student will recycle back through the skill frames, the middle-performance student will be recycled through the practice frames, and the low-performance student will be given special remediation. Thus, each level of student will receive lesson material for remediation that he has not seen before. After the satisfactory completion of each posttest criterion problem, the student will continue in like manner thru a series of task subelements until he meets the requirements of the task element.

The task element problem may consist of a sufficient number of parts, to determine if the student has attained the objective. A successful student will go on to the next task element. Unsuccessful students will be provided remediation based on their performance record. High- and middle-performance students will receive selective remediation, whereas low-performance students will, at the instructional programmer's option, be given detailed remediation or recycled back through the teaching units. After the satisfactory completion of the task elements within the lesson, the students are given a lesson test.

All students who pass the test with less than 100% are provided with a summary of questions they missed and an opportunity to answer those questions again. Any student who fails, but remains above a critical score, e.g., 50%, receives selective remediation and is permitted to answer the questions missed a second time. The student who gets below a critical score is recylced thru the lesson. In this event, the student's record will be temporarily altered to indicate prior experience. The rationale for this is that the student has gained an experience factor and will be given the pretest criterion problems, thus permitting him to bypass those skills and knowledges where he has gained competency. An appropriate printout of the results are supplied to the instructor in real-time at this point in a phase. The student will be given a phase test at the satisfactory completion of a number of lessons. A critique of the phase test, in accordance with school policy, will be given each student that passes the phast test. He will then advance to the next phase. In the event the student fails the phase test, appropriate administrative action will be initiated.

INSTRUCTIONAL STRATEGIES

It is the instructional strategies that are used to make the kind of decisions normally made by the instructor. These decisions are based upon such factors as performance, aptitude, and responses to questions or problems. The strategies are the most fluid and dynamic subset of the model, continually being added to and modified, within the confines of the model, to accommodate unique problems presented by the subject matter or the equipment being taught. Therefore, the strategies discussed herein must be considered as the initial set.

Pretest Criterion Problem

The use of the pretest criterion problem (fig 2) serves to increase the efficiency of training by providing a means whereby a student with prior experience will have an increment of his skill or knowledge evaluated so that he may skip those portions of the lesson. Another function of the pretest criterion problem is to permit a student who has failed the lesson test with a score below a critical value, e.g., 50%, to be recycled thru the lesson, but skip those portions of the lesson he mastered.

Students without prior experience and those who fail the pretest criterion problem are directed to the skill segment. Failure of the pretest criterion problem does not affect the student's performance history.

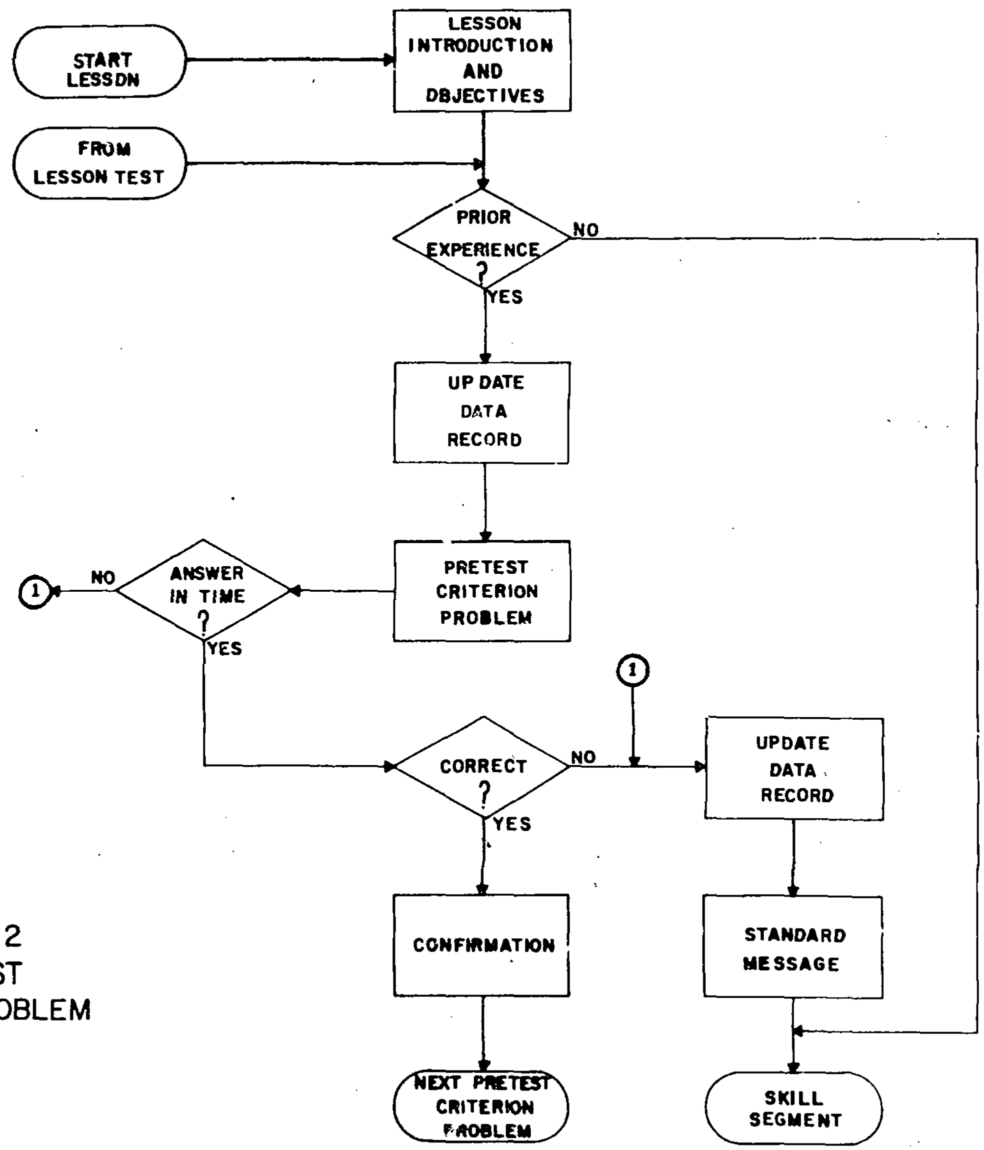

FIGURE 2
PRETEST
CRITERION PROBLEM

In order that the pretest criterion problem properly performs its task, the following guidelines control its construction:

a. The problem may be a written question, either multiple choice or constructed response; or some measurable task performed to an acceptable skill level. The problem may consist of several parts, each of which must be performed to an acceptable level.

b. Clues , hints, or suggestions shall not be employed in the context of the problem.

c. The problem shall reflect the skill or knowledge to be taught in the skill segments.

d. Each problem shall include an "I don't know" alternative to minimize guessing.

A provision for data collection is made within the strategy of the pretest criterion problem. This data will show the relationship between the number of students who are offered the pretest criterion problem and the number who complete it successfully. This count will include the students who are recycled for failing to achieve the critical vlaue on the lesson test.

Skill Segment

The Skill Segment is that subset of the instructional model that is used to teach a single concept or skill. A number of skill segments are required to teach a task subelement. The skill segment shall be taught using the self-paced training mode and media most suitable to the skill or concept to be learned. However, this report will discuss in detail only the CAI mode of training.

A student's learning path thru the skill segment is predicated upon his prior performance. Upon entering a skill segment, the student's prior performance is checked (fig 3) and he is then routed to the preskill frame if he has a high prior performance, or to the skill frames if he has a middle- or low-prior performance.

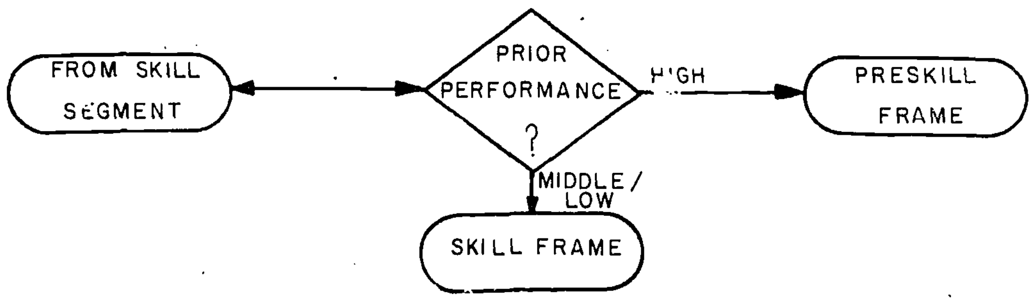

FIGURE 3 PRIOR PERFORMANCE BRANCH LOGIC

Students with middle- or low-prior performance are provided with a series of skill frames designed to teach, in small increments, the skill or concept to be learned.

The skill frame may consist of a brief narrative instruction or task explanation, followed by a question or problem. When the student answers the question or enters the solution to his problem, his response is checked by the computer, at which time reinforcement or confirmation is provided for a correct response; or remediation, based upon the student's answer, is presented for a wrong response. Under no circumstances will a student be allowed to continue unless he answers correctly. Figure 4 illustrates a typical skill frame strategy. Note that assistance is provided under certain conditions such as the student using the same wrong answer twice. This assistance may be an instructor call, special study assignment, or remedial frame.

To reduce text writing by the instructional programmer, standard messages are used for timeouts and unanticipated responses. A series of these standard messages will be available for use. These messages will tell the student what his error is and remind him of the assistance that is available.

After one or more problems, a series of practice frames are provided for reinforcement for the low-performance students. These practice frames may be at the end of a series of skill frames or interspersed within the skill segment as deemed appropriate by the instructional programmer. A typical practice frame strategy is found at figure 5.

The practice frames are prepared to reinforce a skill or concept, rather than teach the concept or skill, therefore, care must be taken to provide drill and practice of concepts or skills just learned.

A point to note in the practice strategy is the use of the count made of successful first attempts that permit a student to continue the lesson when a standard is met.

Posttest Criterion Problem

The posttest criterion problem is a test problem. Its purpose is to ascertain that the skill or concept taught in the task subelement has been learned. There are three entry points into the posttest criterion problem: one from the preskill frame for the high-performance students; another from the series of skill frames for the middle-performance students; and lastly, from the practice frames for the low-performance students. The posttest criterion problem may consist of several parts, both performance and written. Remedial branching is based on performance. Low-performing students get remediation based on the problem area they failed; middle-performing students branch back to the practice frames and high-performance students go back thru the skill frames. Thus, it can be seen, that

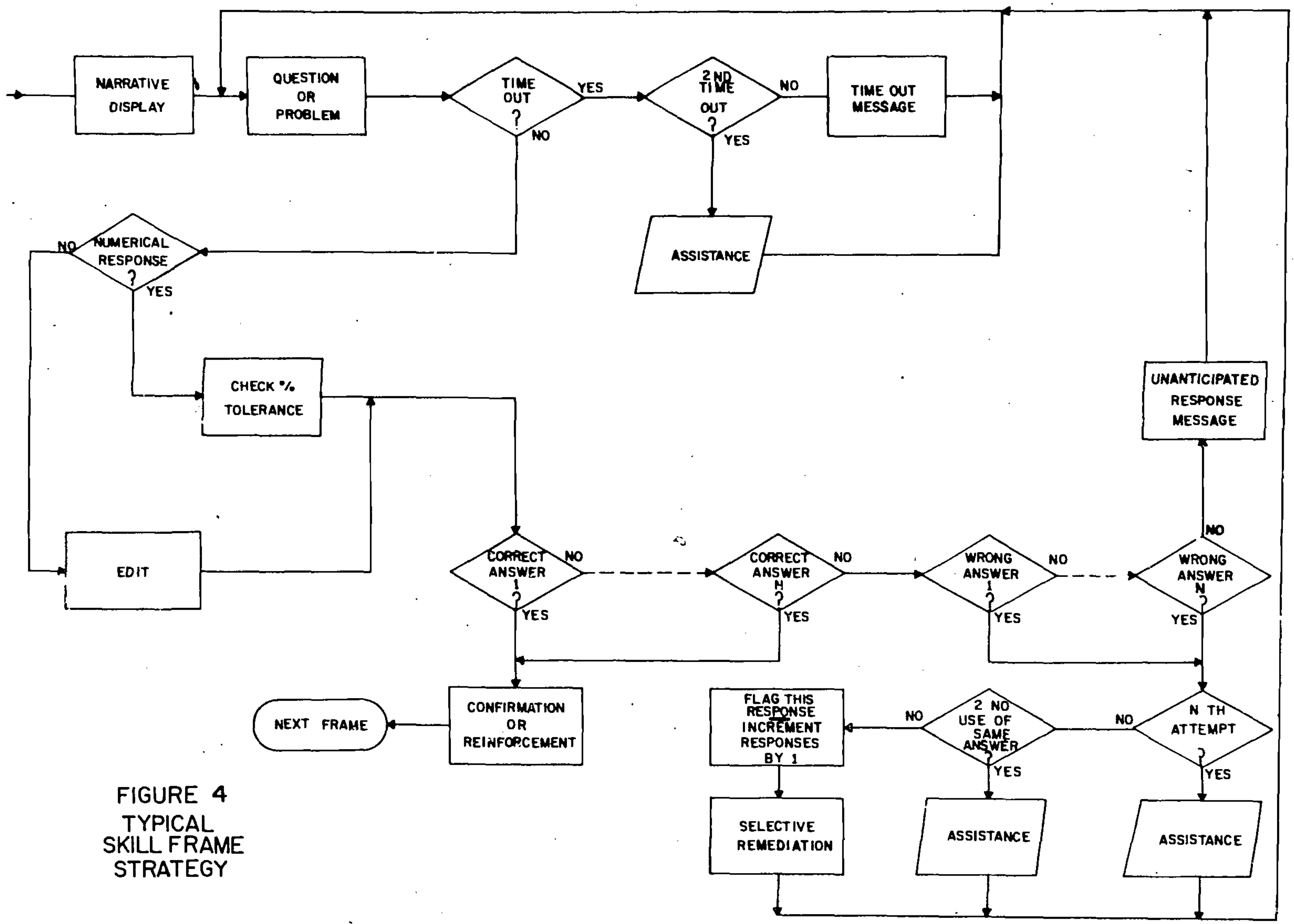

FIGURE 4
TYPICAL
SKILL FRAME
STRATEGY

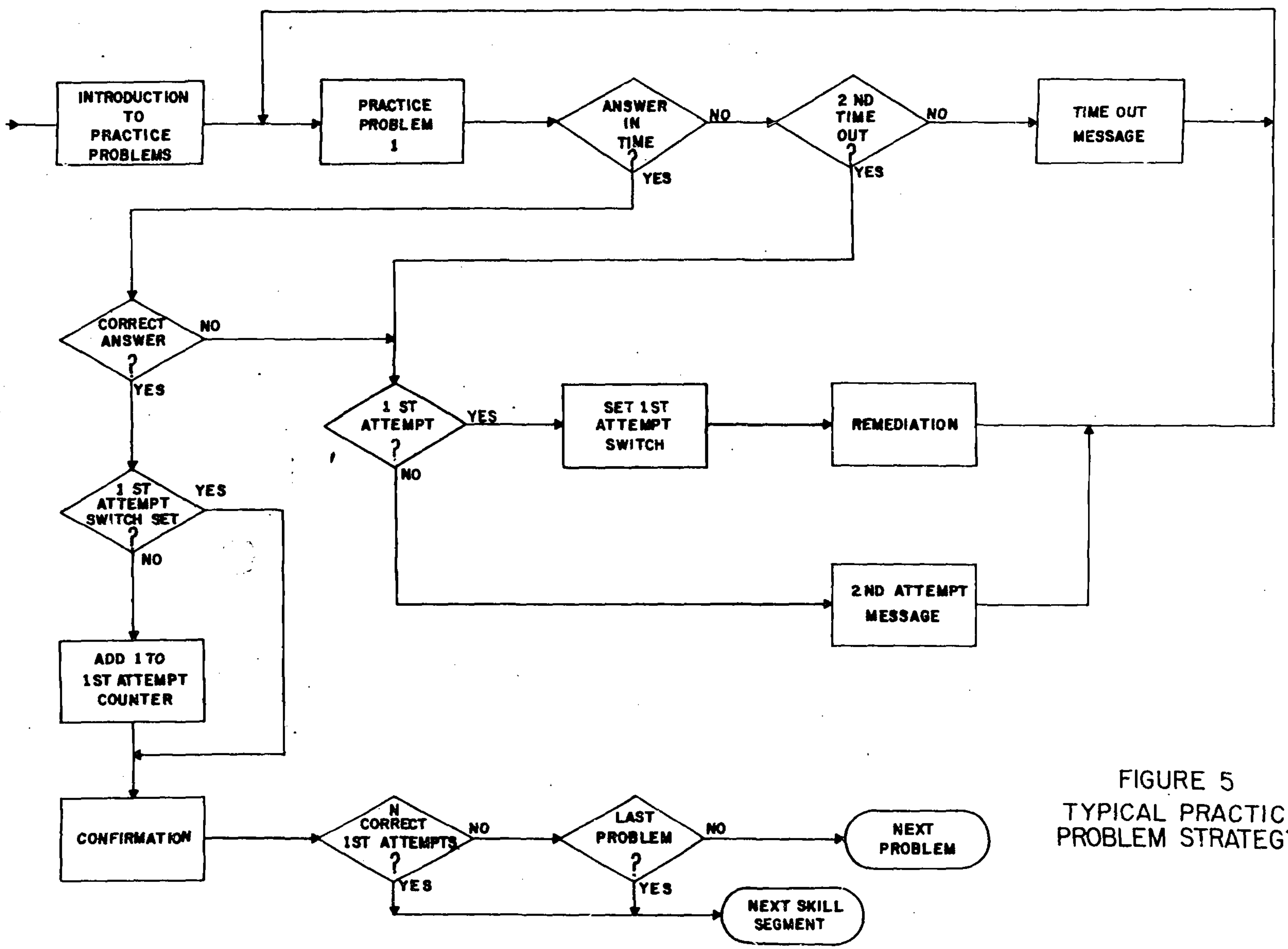

FIGURE 5
TYPICAL PRACTICE
PROBLEM STRATEGY

each level of student receives remediation that is of greater detail than the initial presentation of the subject matter. Figure 6 provides a typical detailed strategy for a posttest criterion problem. Upon satisfactory completion of the posttest criterion problem, the performance record is altered and the student continues on to additional task subelements until he has learned all the concepts and acquired all the skills required for a task element of the lesson.

Task Element

The task element problem is a test problem designed to evaluate a student's capability to accomplish the task set forth in a performance objective. The problem may consist of several parts, both performance and conceptually oriented. Branching is based on performance as is done in the posttest criterion problem. The high- and middle-performance students receive selective remediation before they attempt the problem a second time. There are two options provided for use by the instructional programmer for remediation for the low-performance student. The instructional programmer provides detailed remediation in the form of off-line texts, on-line displays or other study media; or the student can be branched back to repeat the task element. Upon satisfactory completion of the task element problem, the student's performance is evaluated and his performance record updated accordingly. The student will go on to the next task element and its associated skills and concepts. After the last task element, the student is given a lesson test. For a typical scoring strategy, refer to figure 7.

Lesson Test

The lesson test is designed to evaluate a student's grasp of the skills and concepts within a lesson. A lesson will cover a pedagogically appropriate segment of instruction that would span about four to eight hours of instruction for the middle-performance student. The lesson test may be a combination of concepts, questions or multipart skill problems. A flow chart of the lesson test logic is found at figure 8.

A student will go thru each problem or question in sequence. At the completion of the test, a determination is made as to pass or fail. All students who pass with less than 100% receive a summary of each missed question or problem and then are given an opportunity to respond a second time. Failure to answer correctly a second time, results in a detailed explanation of the item with the answer provided. Thus, a student will not go on to the next lesson until he either answers each item correctly or is provided with the answer to each item.

The student who fails the lesson test, but achieves above a critical score, e. g., 50%, will receive selective remedation for each item missed and then be

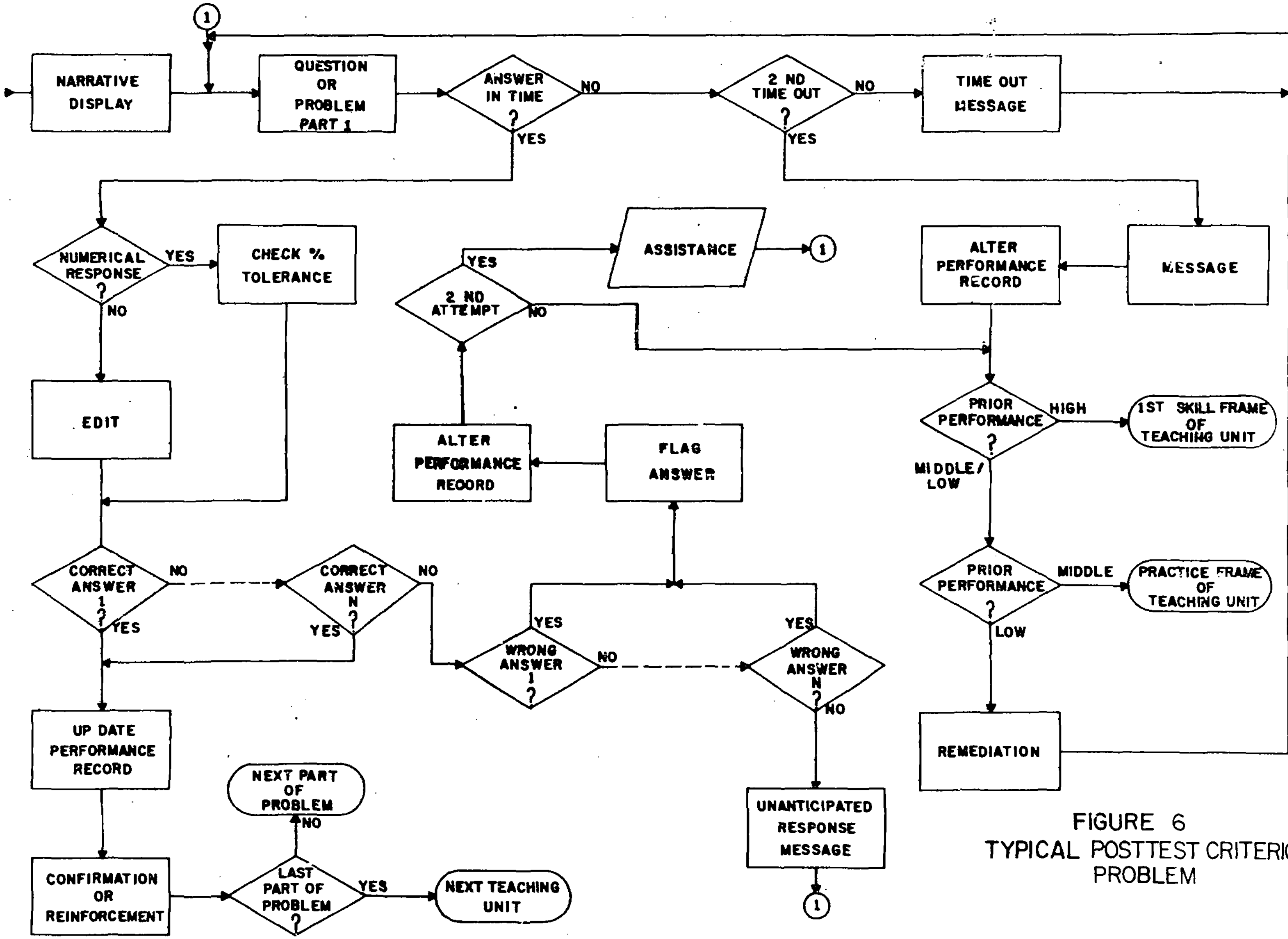

FIGURE 6
TYPICAL POSTTEST CRITERION PROBLEM

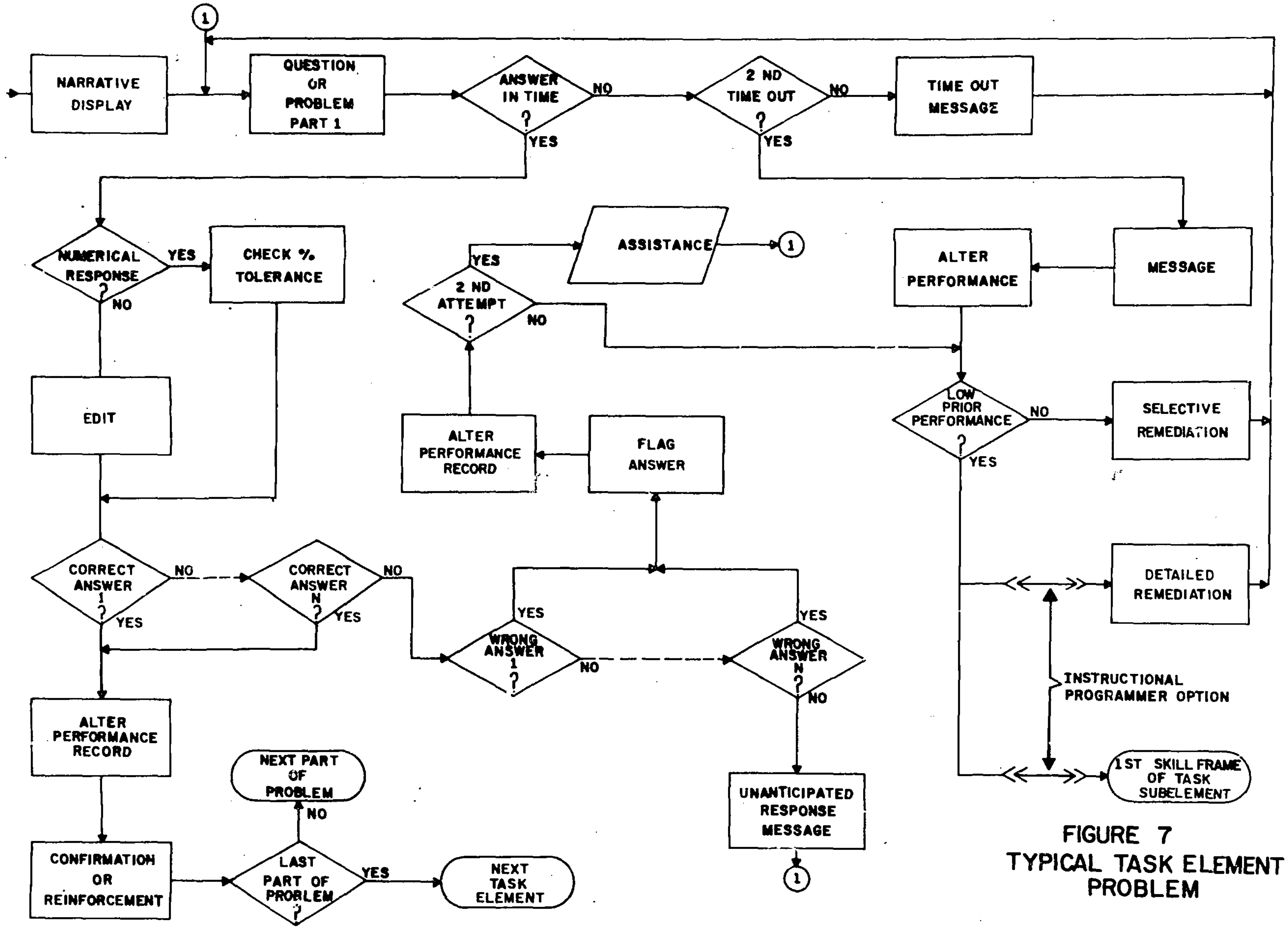

FIGURE 7
TYPICAL TASK ELEMENT PROBLEM

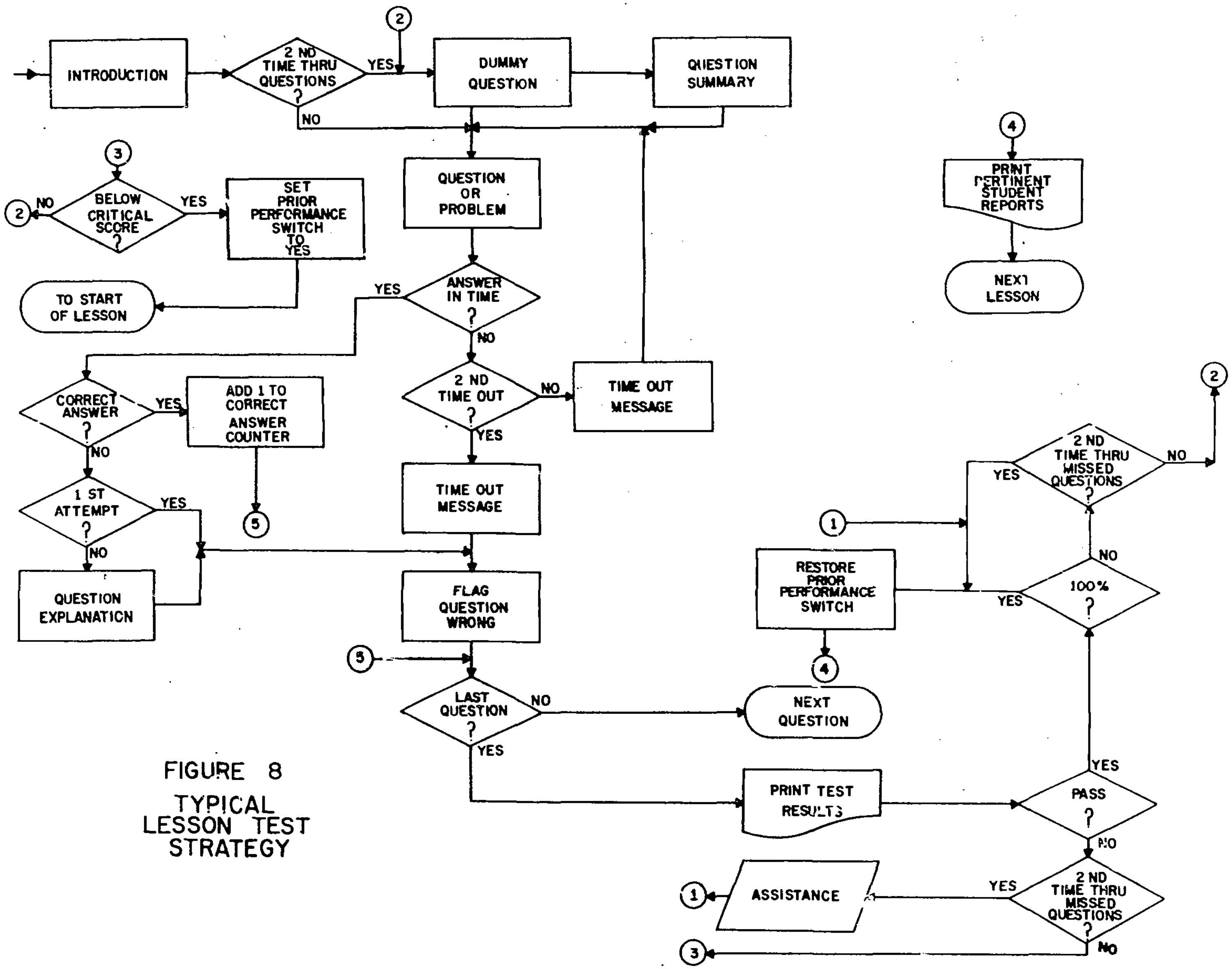

FIGURE 8
TYPICAL LESSON TEST STRATEGY

given the opportunity to retake only those items missed. However, if a student fails to achieve even the critical score, his prior experience record is changed to indicate prior experience and he is branched back to the beginning of the lesson. The rationale for setting his prior experience indicator to "yes" is that he now has experience in the subject matter and thus, will be permitted to take the pretest criterion problem enabling him to bypass any portion of the lesson where he demonstrates he has satisfactory competency. The prior experience indicator will be set to its original state when the student completes the lesson test.

An automatic printout will be generated at the instructor station for each student when he completes the lesson test. As a minimum, the printout will contain the student's name, identification number, the passing score, the student's score, date, time, the attempt at taking the test, and the identifier for each item missed. This printout will be immediately available to the instructor, so that he can give tutorial assistance to any student who fails the test twice. Additionally, the printout can be inserted into the student's class record folder for future reference. At the completion of a lesson test, a record of the student's progress will be printed. The printout will contain such data as the student's elapsed course time, average student's time at this point, and predicted course completion date. The student will then enter another lesson at the satisfactory completion of a lesson test.

Phase Test

A phase test will be administered at the completion of a number of lessons. The phase test may be on line, off line, or a combination of on line and off line. It may also be written, performance, or a suitable combination of both. The phase test will cover a logical block of subject matter spanning two to three weeks of instruction for the average student. All students who pass the phase will be provided with a critique of the test following procedures established by the school. All failing students will be dealt with according to established administrative procedures.

CONCLUSION

The instructional model described in this report represents a significant evolutionary advance over the model described in Technical Report 71-2 inasmuch as it includes a number of the suggested considerations proposed in that report.[2] The learning path is determined by the student's performance rather than a predetermined aptitude level making it more sensitive to the student's needs.

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[2] USCONARC, Technical Report 71-2, pps 18-19

Though the model is essentially single track, its efficiency is improved by permitting students to bypass certain areas based on their performance. Remediation is also provided based on demonstrated performance.

The model described in Technical Report 71-2 is a CAI model that makes no provision for CMI modes. This model makes provisions for CMI lesson presentations, as well as computer managed practical exercises and tests.

The responses latency was addressed to reduce model directed instructor interventions, placing the onus for assistance upon the instructional programmer within the confines of the model rather than the instructor in the event of multiple timeouts and use of the same wrong answers.

This model has addressed the use of remediation sensitive to the student's problem, but not the origins of the problem. This should be a consideration for future models. Additionally, the use of pertinent games and simulations should be considered in future models.

The effectiveness of this model can only be determined by its use in an on-going training program. The user development orientation of CTS at the Signal School is dedicated to the pragmatic, evolutionary approach to the attaining of its objectives.

ANNEX A

GENERAL COURSE STRUCTURE

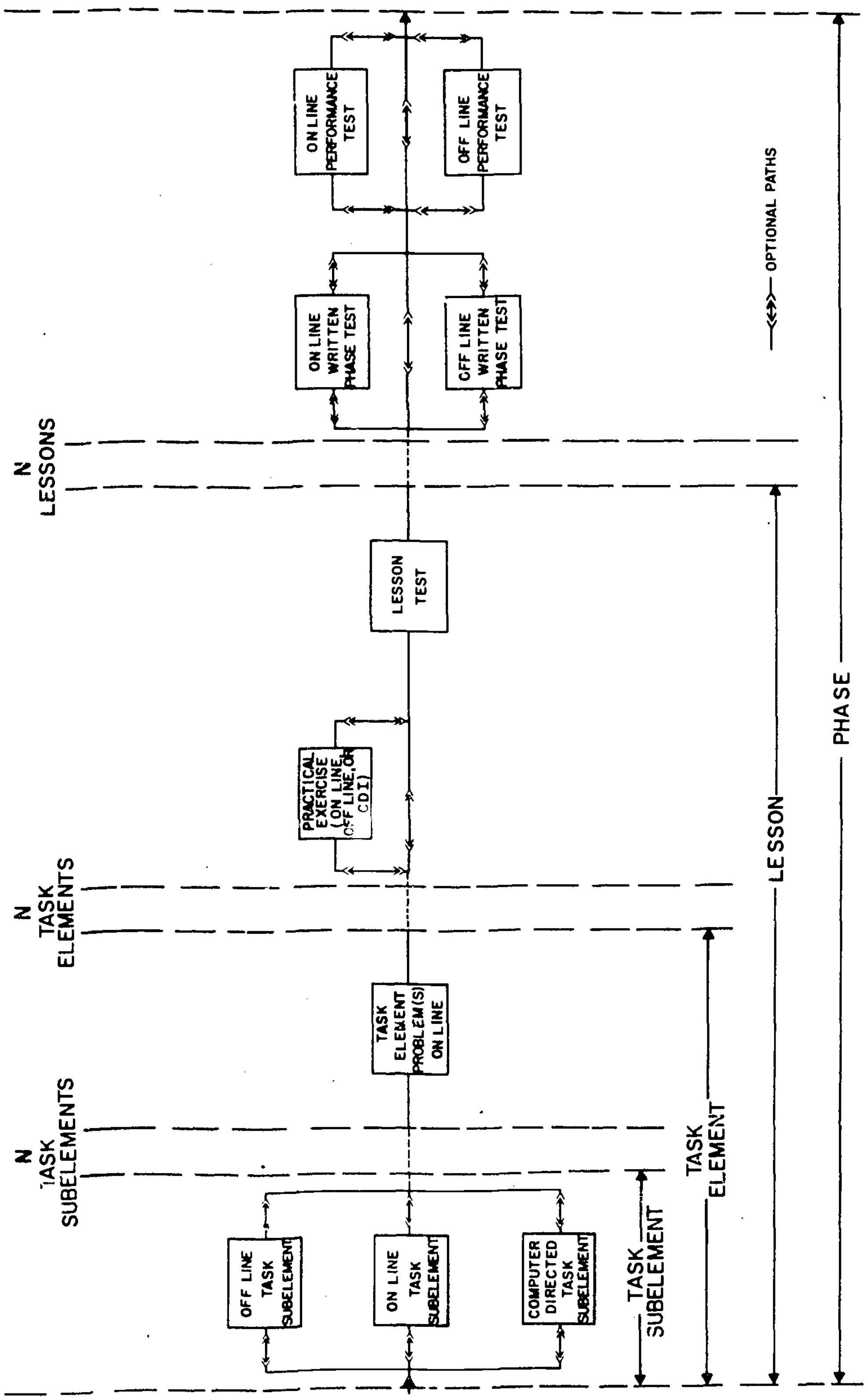
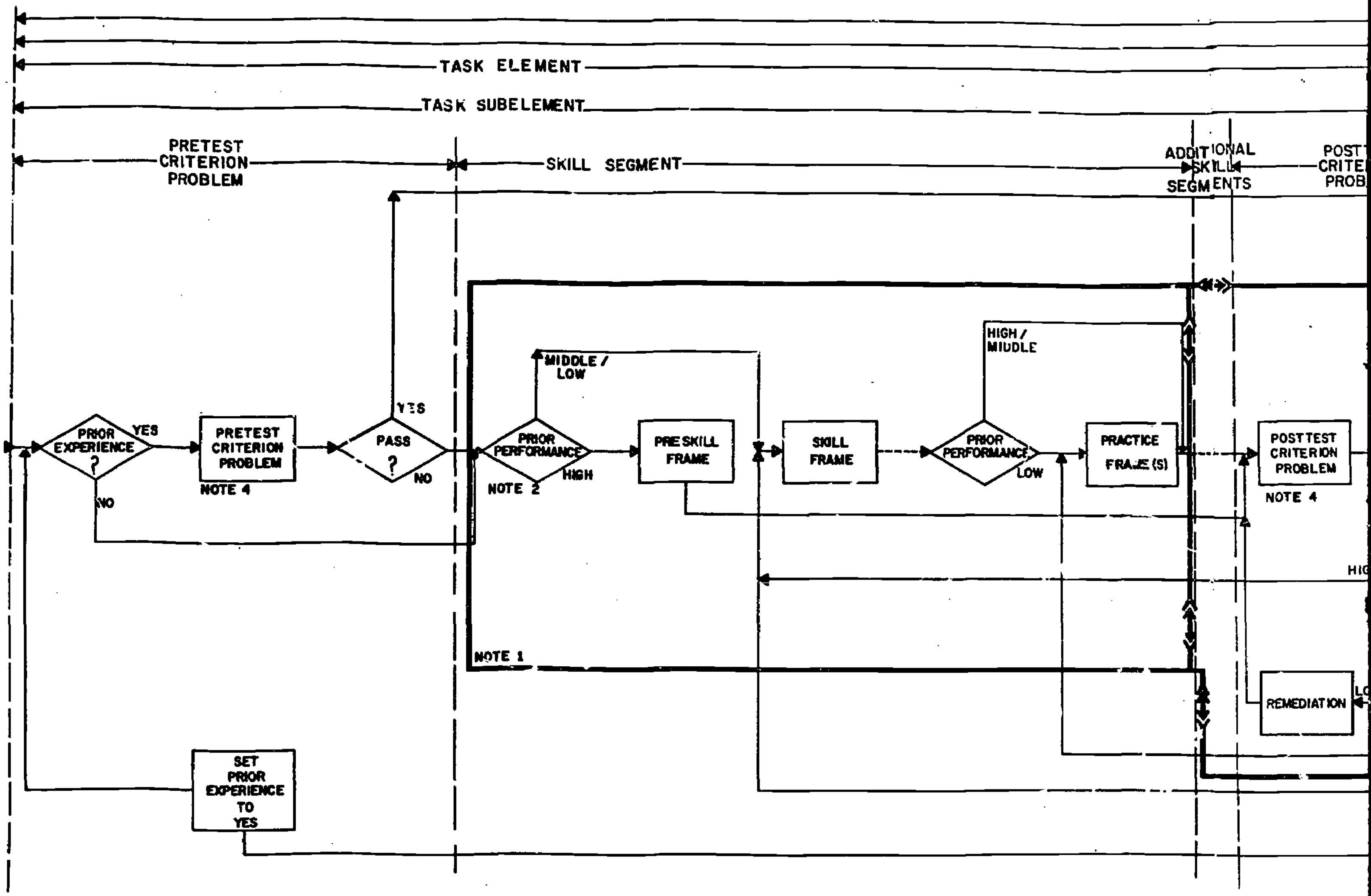
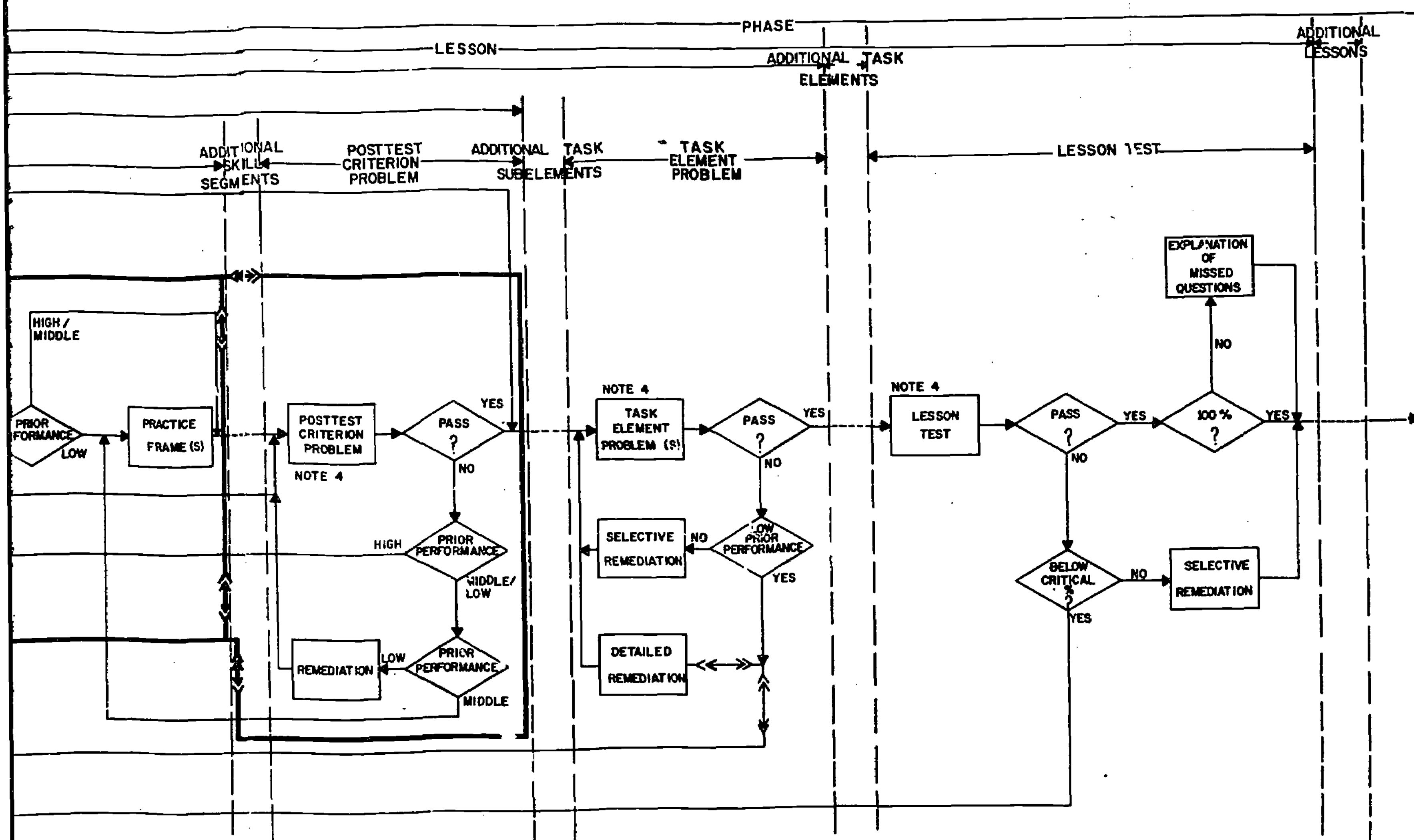


FIGURE A-1

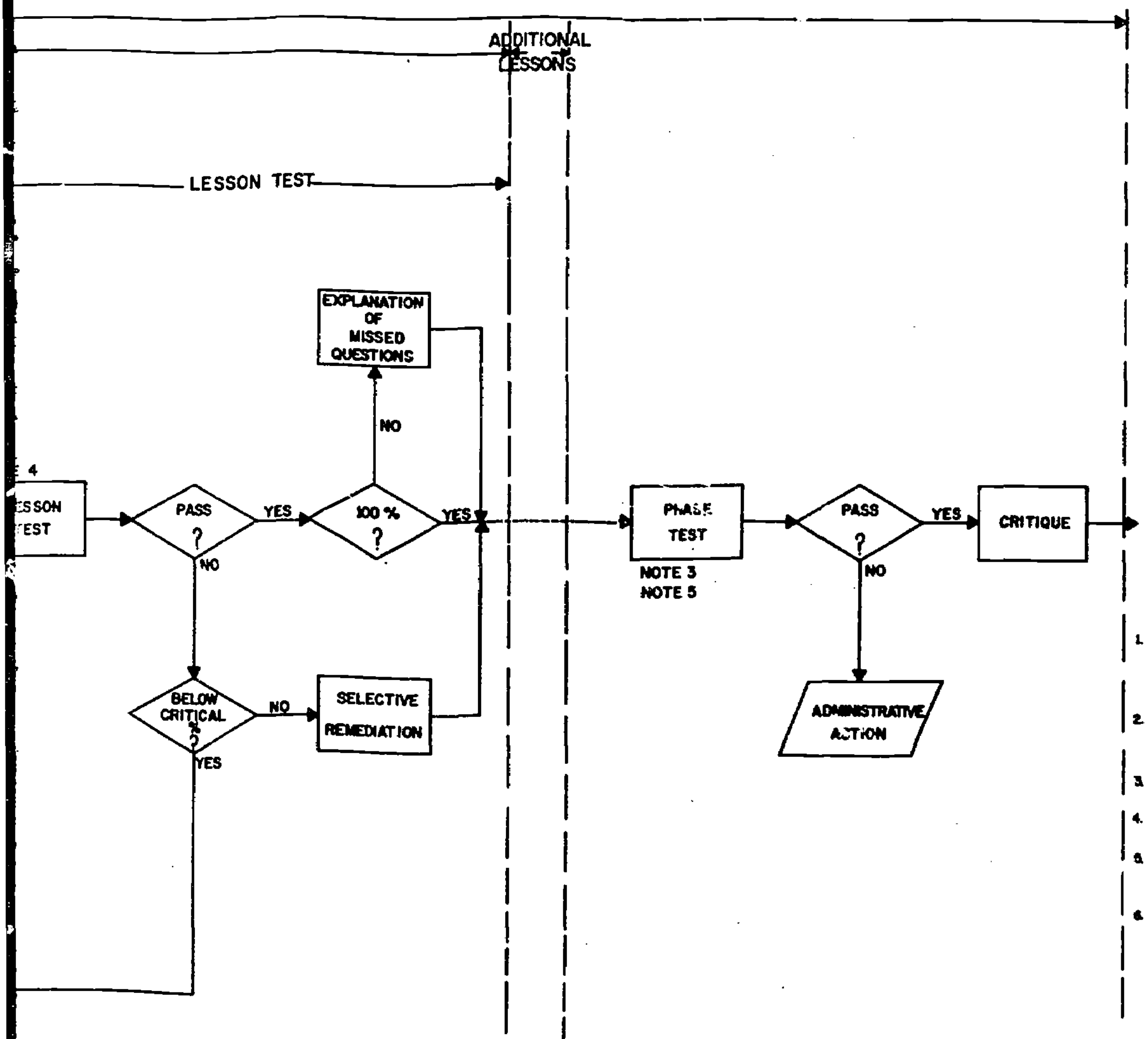


TRAINING DECISION PROCESS CHART

FIGURE A-2



PHASE
LESSON
ADDITIONAL TASK ELEMENTS
ADDITIONAL LESSONS
ADDITIONAL SKILL SEGMENTS
POSTTEST CRITERION PROBLEM
ADDITIONAL TASK SUBELEMENTS
TASK ELEMENT PROBLEM
LESSON TEST
EXPLANATION OF MISSED QUESTIONS
HIGH / MIDDLE
PRIOR PERFORMANCE
LOW
PRACTICE FRAME (S)
POSTTEST CRITERION PROBLEM
NOTE 4
PASS ?
YES
NO
HIGH
PRIOR PERFORMANCE
MIDDLE/ LOW
REMEDIATION
MIDDLE
NOTE 4
TASK ELEMENT PROBLEM (S)
SELECTIVE REMEDIATION
DETAILED REMEDIATION
LOW PRIOR PERFORMANCE
NOTE 4
LESSON TEST
100 % ?
BELOW CRITICAL % ?
SELECTIVE REMEDIATION



1. THIS IS A CAI SKILL ELEMENT. IT COULD ALSO BE COMPUTER DIRECTED INSTRUCTION OR ENTIRELY OFF LINE USING A DIFFERENT MEDIA.
2. INITIAL PRIOR PERFORMANCE MIGHT BE ESTABLISHED BY KEY ACB SCORES, EL SCORE, OR OTHER MEANS.
3. THERE WILL BE A TEST AFTER EACH PHASE.
4. STUDENT PERFORMANCE RECORDED AT THIS POINT.
5. IF THIS TEST IS ON LINE, STUDENT PERFORMANCE WILL BE RECORDED.
6. —<<⟷>>— INSTRUCTIONAL PROGRAMMER OPTIONS.

GLOSSARY

This glossary is provided to clarify the use of terms within the context of this report.

CAI - Computer Assisted Instruction. The use of the computer as a multiple instructional mode teaching medium, functioning interactively with the student providing him with lesson material and evaluating his interaction with the lesson material. The lesson material and teaching logic is stored within the computer memory.

CDI - Computer Directed Instruction. The interactive use of the computer as an adjunct to and a director of other media of instruction. In this mode, the computer is used to interact periodically to check the student's progress and provide remediation if needed, and further directions on how to proceed. The computer may be one of several media used.

CMI - Computer Managed Instruction. The use of the computer as a classroom management tool. In this mode, the computer is used to grade tests, prescribe remedial work, prescribe lessons to be studied, designate media to be used, schedule equipment and media, and monitor student progress.

CTS - Computerized Training System. The intergration of the computer into a totally self-paced training system. In a CTS, the computer serves as a teaching medium, a surrogate instructor, a classroom management tool, and as well as performing many school administrative functions associated with training.

Display - The presentation of text and graphics on the display device using contiguous display commands which is limited to a single screen presentation.

Frame - A component in the instructional process. A frame will contain one or more displays, e.g., a Skill Frame will consist of a message display, a question display, and the remediation and reinforcement displays.

Instructional Mode - Methods of teaching to include: tutorial, drill and practice, simulation and gaming, problem solving and others.

Instructional Programmer - The individual responsible for developing lessons for CTS. The instructional programmer's duties under the "one man concept" in a CTS encompass the following: authoring of lesson text, both for on- and off-line presentation; preparation of the computer coding essential to the execution of the on-line lesson material; testing, debugging and editing of the lessons; and design and development associated graphics and training devices.